Critique of MEN Theory Draft

Overview

This document critiques the MEN (Maximally Entangled Nonspace) theory draft. The goal is to identify where reasoning is inconsistent, overstated, or in tension with existing data, and suggest concrete fixes to make the theory defensible.

1. QFC/QES → MEN Boundary Assumption

The draft assumes that capacity-saturated Quantum Extremal Surfaces (QES) become reflective MEN boundaries. This is not derived from the Quantum Focusing Conjecture (QFC), only asserted. Persistence and reflectivity require extra assumptions that are not justified.

2. Reflectivity Law Not Unique

The Lorentzian reflectivity law is derived from a scalar toy model and is not unique. Gravitational waves (spin-2 fields) in Kerr spacetime would produce more complicated frequency responses. Calling it unique is overstated.

3. Echo Corridor Over-Specified

Echo predictions (0.3–0.5s at 100–200 Hz) are claimed universal, but in fact echo delays depend strongly on black hole mass, spin, and cavity size. The claim contradicts the theory's own formulae. Observations so far show no statistically significant echoes.

4. Interior vs Exterior Surface Confusion

MEN boundaries are sometimes described as inside black holes. Echoes require an exterior, near-horizon surface to be observable. This is a conceptual inconsistency.

5. Cosmology: Tensor→Scalar Implausibility

The draft proposes scalars are seeded entirely from tensor-to-scalar conversion while keeping the observed amplitude and tilt. This is numerically implausible without violating limits on the tensor-to-scalar ratio (r). The proposed corridor (r=0.017–0.036) is already under tension with BICEP/Keck limits.

6. Non-Gaussianity Largely Ignored

Tensor-sourced scalars should produce significant bispectrum signals. Current Planck constraints on f_NL are tight, but the draft does not calculate amplitudes. Without explicit predictions, falsifiability is weak.

7. Observer Dependence Overreach

Claiming the same invariant surface looks like both a reflective boundary and an initial-condition surface is a category error. Coordinate slicing cannot change dynamics. This should be reframed as distinct realizations linked by a shared parameter.

8. Cross-Domain Δ Assumption

The same entanglement gap Δ is required to explain both black hole echoes and primordial perturbations. This universality is not justified. A renormalization or scaling argument is missing.

9. Information Conservation Ansatz

The chosen reflection/transmission ratios are one possible unitary parametrization. They are not unique. The draft should acknowledge other causal, unitary frequency responses.

10. Tension with Literature

No firm detection of echoes exists; reviews emphasize this. Backreaction arguments suggest echoes may be suppressed. These counterarguments must be addressed directly.

Suggested Fixes

- Reframe Lorentzian reflectivity as a minimal ansatz, not unique law. - Standardize MEN boundary as near-horizon exterior, not interior. - Present mass–spin–ε dependent echo bands, not a narrow universal corridor. - Explicitly compute scalar amplitude, tilt, and bispectrum from MEN predictions. - Acknowledge current null results and bounds in both gravitational waves and cosmology. - Tone down cross-domain universality of Δ unless supported by a scaling argument.

Conclusion

The MEN framework is ambitious and testable, but current derivations overstate uniqueness, misstate boundary locations, and ignore constraints. To survive peer review, the theory must be tightened mathematically (spin-2, Kerr backgrounds), predictions broadened to reflect parameter dependence, and cosmological consistency shown explicitly with current observational limits.